



What are atoms and isotopes?

What is fission?

What are atoms?

An atom is the basic component of matter; all matter is divided into over one hundred different chemical elements. It is the smallest particle of an element having all the chemical properties of the element. The center of each atom is a nucleus, which is surrounded by electrons. The nucleus has positive-charged particles (protons) and neutral particles (neutrons). The electrons are negatively-charged particles. There is one electron for each proton in the atom.

What are isotopes?

An isotope is an atom with a specified number of protons and neutrons.

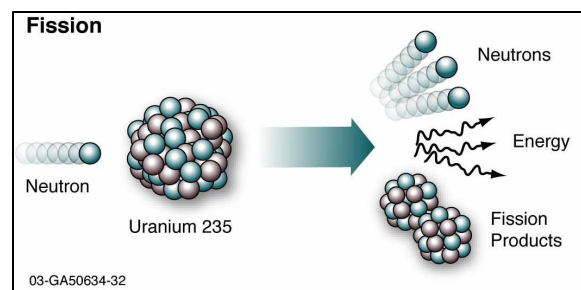
The number of protons determines the chemical properties, so all atoms of the same chemical element have the same number of protons (and electrons). For example, element #92 is uranium, which has 92 protons in its nucleus.

However, the number of neutrons can change without changing chemical properties. So, there may be several isotopes of each element, each with similar chemical properties, but with differing nuclear properties. For example, there are three isotopes of uranium that exist in nature: uranium-238, uranium-235, and uranium-234. Their chemical properties are the same, while their nuclear properties differ. Uranium-238 has 92 protons and 146 neutrons for a total of 238 particles in its nucleus. Similarly, uranium-235 has 92 protons and 143 neutrons for a total of 235 particles in its nucleus.

What is fission?

Some isotopes are unstable, especially those with at least 92 protons, which are uranium and those with more protons than uranium (*transuranic elements*). Such atoms also have a large number of neutrons. Under certain conditions – especially when hit with a neutron – these unstable isotopes split, or **fission**, into two or three “fission products,” two or three neutrons, and great amounts of energy.

The total amount of mass of these products is slightly less than the mass of the original atom. The missing mass has been changed into energy. The amount of energy is given by Albert Einstein’s famous equation, $E=mc^2$, which means the amount of mass times the speed of light, times the speed of light again, tells us the amount of energy.



The neutrons produced from fission keep the fission reaction going by interacting with other atoms and causing some of them to fission. Some of the neutrons cause other atoms to fission.

The fission products are waste.

In a nuclear power plant, the energy from fission is converted into heat, turning water into steam, which then drives a turbine generator to produce electricity. Uranium and the transuranic elements are the source of heat for most nuclear power plants, rather than oil, coal or natural gas.